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Vol. 9
no. 9
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AGRICULTURAL Research

U.S. Department of Agriculture

March 1961

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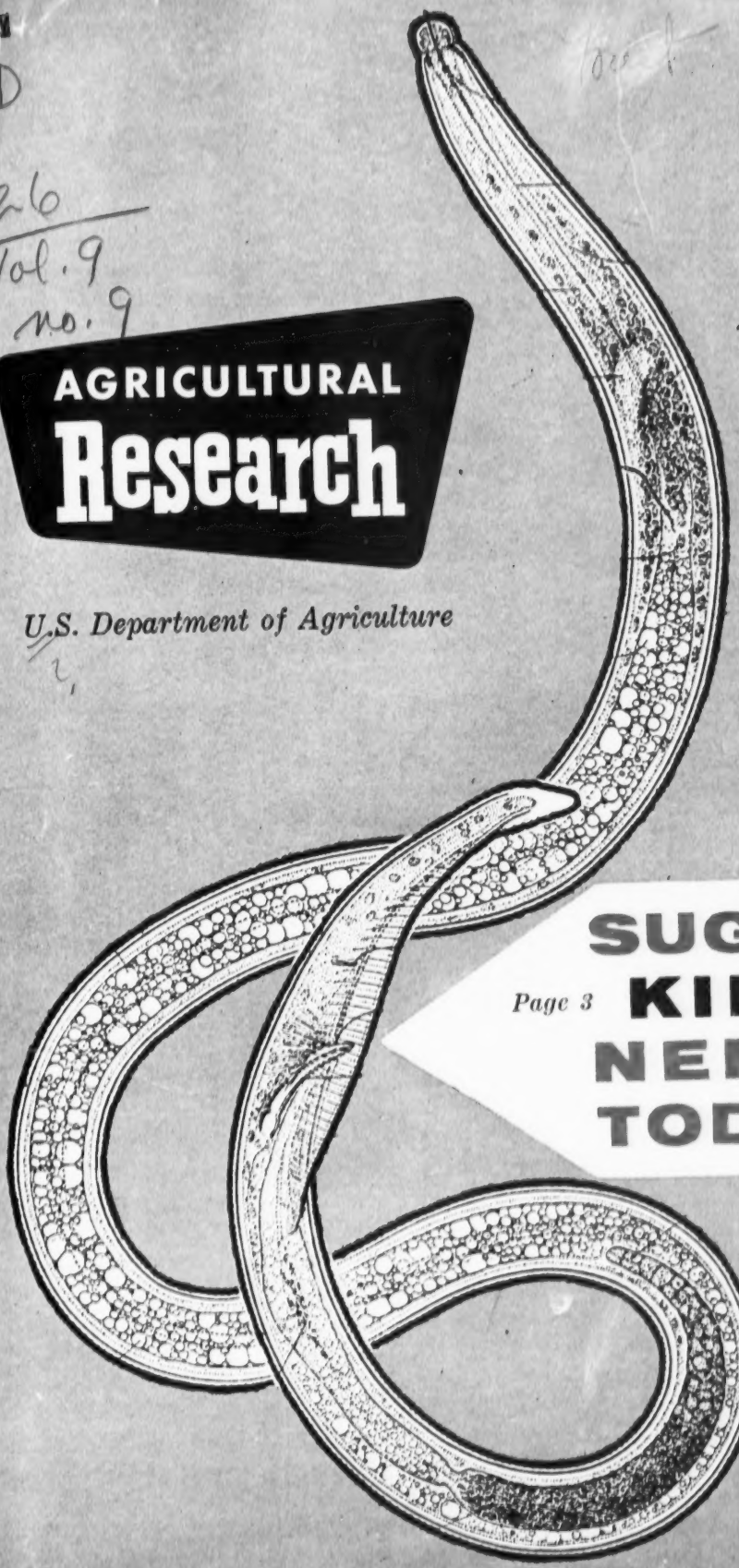

SUGAR KILLS NEMATODES

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AGRICULTURAL
Research

March 1961 / Volume 9, No. 9

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Nutrition

Nutritional research, by defining basic food needs of people everywhere, has made possible the recent worldwide attack on hunger and diseases associated with inadequate diets.

The world is now using knowledge provided by nutritionists to wipe out diseases which have affected, or still affect, hundreds of millions of human beings. This knowledge gives us a promise of adding many years to the productive and enjoyable life of men and women everywhere.

The widespread social consequences of advances in nutrition research are emphasized by indications that the job of feeding the poor, once a matter of charity, has become a matter of duty both nationally and internationally.

World War II intensified scientific interest in *undernutrition* and led directly to postwar concern with *overnutrition*. Observers were struck, for example, by the drastic decrease in the number of patients hospitalized with cardiovascular conditions during the famine accompanying the siege of Leningrad. When the siege was lifted and famine relieved, an *upsurge* in cardiovascular conditions occurred.

Statistical findings of life insurance companies have stimulated interest in obesity and in its associated and causative links to disease. Controversy still rages as to the relative influence of animal and vegetable fats in the diet on disease—especially the cholesterol levels and degree of saturation of the fats, and related factors.

Recent findings emphasize the importance of studying the interaction of constitutional and nutritional factors. For example, research indicates that there are strong genetic determinants in an individual's ability to switch from a high carbohydrate diet to one high in fat without gaining excessive weight. Many other nutritional problems are receiving greater attention, such as the influence of diets on aging.

(Highlights from a USDA Graduate School lecture by Dr. Jean Mayer, associate professor of nutrition, School of Public Health, Harvard University, Cambridge, Mass.; adviser on nutrition to the United Nations.)

AGRICULTURAL RESEARCH is published monthly by the Agricultural Research Service, United States Department of Agriculture, Washington 25, D.C. Printing has been approved by the Bureau of the Budget, August 15, 1958. Yearly subscription rate is $1 in the U.S. and countries of the Postal Union, $1.50 in other countries. Single copies are 15 cents each. Subscription orders should be sent to the Superintendent of Documents, Government Printing Office, Washington 25, D.C.

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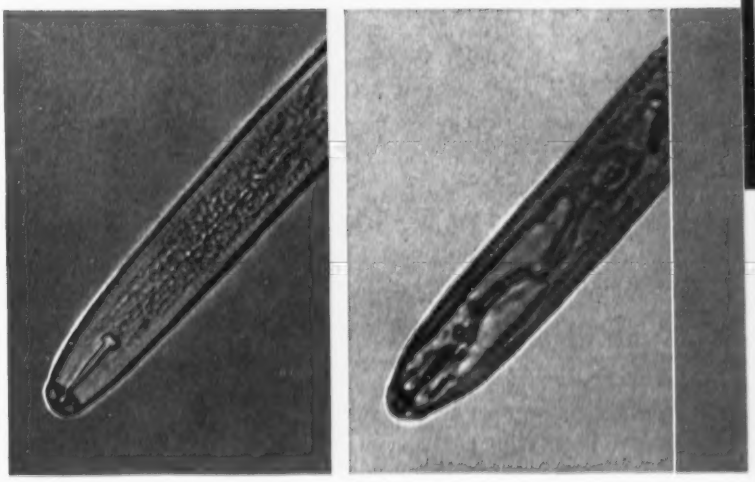

Head and upper portion of normal adult female burrowing nematode (left). Note cavity, caused by dehydration, in the nematode (right) after 5 minutes in a solution of dextrose and water.

SUGAR KILLS NEMATODES

It destroys the pests by causing their cell fluid to enter the soil; death results from dehydration

■ Ordinary sugar is one of the most effective nematocides ever tested, according to a recent report from USDA's Horticultural Field Laboratory at Orlando, Fla.

After being mixed with nematode-infested soil, at rates of 1 to 5 percent by weight, sugar killed up to 100 percent of the nematodes within 24 hours. Destruction was so complete that no microscopic trace of the nematodes could be detected.

These findings, by ARS plant pathologist W. A. Feder (see cover) and associates, are the first demonstration of nematocidal activity in a material not generally classed as toxic. Feder says the sugar kills the pests by increasing the osmotic pressure of the soil solution in which they live. He explains the killing process this way:

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SUGAR KILLS NEMATODES

(Continued)

Enough sugar is added to the soil to produce a greater amount of dissolved solids in the soil solution than in the cell fluid of the nematodes. Because liquid tends to move from a less concentrated solution to one more highly concentrated (osmosis), the body fluid moves out of the nematodes, and they die as a result of dehydration (exosmosis).

Sucrose was being tested as a nutrient

Feder discovered the nematocidal activity of sugar when he added sucrose (cane sugar) to soil to test the sugar's value as a nutrient for increasing populations of nematodes and of nematode-capturing fungi. Twenty-four hours later, he found a sharp reduction in the number of nematodes in the soil samples.

In followup tests, in which sucrose was added to nematode-infested soils at the rate of 5 pounds per 100 pounds of soil, all nematodes were dead within 24 hours. Some killing was evident after 10 minutes in soil containing as little as 1,000 parts per million of sugar. The possibility that a pathogenic agent instead of sugar was killing the nematodes was ruled out by obtaining similar results when nematodes were added to steam-sterilized soil-sugar mixtures. Nematodes thrived in a weak sucrose-water solution, which showed sucrose itself was not toxic to them.

These findings led Feder to theorize that the nematodes may have been destroyed by the higher osmotic pressure created by the sugar in the soil solution. To test this theory, he placed nematodes in distilled water containing sucrose or glucose in amounts ranging from 1 to 100 percent on a weight-volume basis. Osmotic pressure in the solutions varied from 0.67 atmospheres to 120 atmospheres (1 atmosphere is roughly equal to air pressure at sea level).

Within an hour, all nematodes were dead in the solutions containing 30 to 40 percent sucrose or 10 percent glucose. Osmotic pressures of these solutions were about 22 atmospheres for the sucrose and 12 atmospheres for the glucose.

Pests died after only 15 minutes

Nematodes removed from the sugar solutions within 10 to 15 minutes and placed in tap water usually recovered form and motility. But those removed after 15 minutes were seriously injured and eventually died.

The test was carried further by adding sugar to samples of nematode-infested soil of varying moisture contents. As the amount of moisture went down, sugar concentration and nematode mortality went up.

Feder concluded that the addition of specific amounts of sugar to nematode-infested soils of known moisture content will result in predictable percentages of nematode kill.

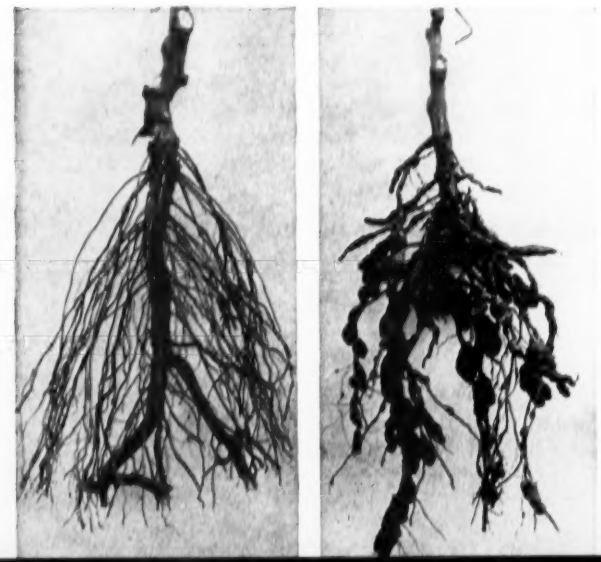
The laboratory findings were confirmed

Greenhouse and field tests confirmed these laboratory findings. Okra, corn, Duncan grapefruit, and sour orange plants grown in nematode-infested soil, to which sugar had been added before planting, had roots that were free of nematodes. (The nematode species included parasites such as burrowing, citrus, lesion, awl, sting, and root-knot, as well as nonparasitic, free-living nematodes.) The amount of sugar required varied with the amount of moisture in the soil at time of treatment. With soil moisture at 1 to 2 percent, for example, 1 percent of dextrose effectively reduced root-knot nematodes on okra.

Okra plants grown in sugar-treated soils were healthier and produced more roots with less galling than plants in untreated soils. Growth of corn and citrus was apparently retarded. But the citrus plants in the greenhouse recovered when the sugar was flushed out of the soil with water 24 hours after treatment.

Nematodes are among the world's most destructive parasites. They are very widely distributed and probably damage every crop each year. Uncontrolled infestations often build up to the point that land becomes unfit for economical production.

Since sugar is nontoxic, readily available, and relatively inexpensive, it may offer a practical means of controlling nematodes in many areas. Research now underway may reveal other compounds that are equally effective at lower application rates.☆



Grape seedling stock (left) is free of nematode injury. But roots of stock (right) show much evidence of galling produced by the root-knot nematode.

Here's a promising face fly control

Organic phosphorus insecticides may also aid in controlling horn, stable, and houseflies

■ Near-perfect control of the bothersome and widespread face fly has been achieved—in the laboratory—by adding a small amount of some insecticides to dairy cattle feed.

Experiments show that certain organic phosphorus insecticides pass, largely undigested, through cattle and make their manure highly toxic to face fly larvae. These larvae develop *only* in fresh manure. This research was conducted at USDA's Agricultural Research Center, Beltsville, Md. Similar studies there indicate this method also may aid in controlling the housefly.

At Corvallis, Oreg., in research headed by ARS entomologist G. W. Eddy, scientists earlier found that some insecticides might help control the hornfly, stablefly, and housefly breeding in manure. Results of these studies, during screening of various insecticides for use as systemics, encouraged the research at Beltsville.

Although no insecticides have been approved for this use (questions concerning residues in meat and milk aren't completely answered), scientists consider the results timely and significant.

The face fly has become a troublesome cattle pest in the U.S. and is continuing to spread. Since being found in New York in 1953, the insect has infested nearly all areas east of the Mississippi River and north of Tennessee and South Carolina. During 1960, face flies were found for the first time in Iowa, Missouri, Connecticut, Maryland, Tennessee, and North Carolina (AGR. RES., December 1960, p. 5).

Holstein heifers were fed the insecticides for 5 days

At Beltsville, entomologists D. W. Anthony and Otelia Bodenstein, and dairy husbandman N. W. Hooven, fed three insecticides—separately in a grain ration—to Holstein heifers for 5 consecutive days.

Insecticides tested were: ronnel [*O,O*-dimethyl *O*-(2,4,5-trichlorophenyl) phosphorothioate], Co-Ral [*O*-(3-chloro-4-methylumbelliferone) *O,O*-diethyl phosphorothioate], and Bayer 22408 [*O,O*-diethyl *O*-naphthalimido phosphorothioate].

Manure collected from the animals was then infested with newly hatched face fly larvae. Few larvae survived after cattle received daily dosages of only 2.5 milligrams (mg.) of ronnel per kilogram of bodyweight, or 0.5 mg. of Bayer 22408 or Co-Ral. (One milligram per kilogram is equivalent to 0.0016 of an ounce per 100 pounds of bodyweight.)

In the Beltsville experiments, partial control of the *housefly* resulted when the insecticides were used at the low (2.5 and 0.5 mg.) dosage rates. At double these rates, control approached 100 percent.

It's possible that smaller dosages might work

Minimum effective rates weren't determined for the insecticides tested. It's believed, however, that even smaller amounts might effectively control the face fly.

Relatively few organic phosphorus insecticides have been screened for this type of control. More research is needed to learn which chemicals are most effective, safest to use, and least expensive.

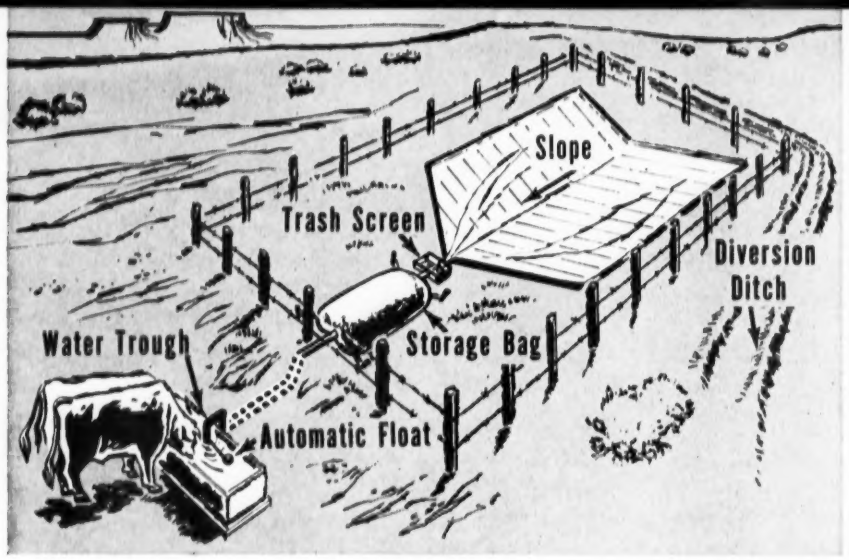
When these chemicals are found, it's possible minute quantities may be mixed into salt licks. Then the face fly could be controlled most efficiently. But community effort would be needed for maximum benefits.

Insecticides might not be the only control. The face fly has existed many years in Europe without becoming a serious livestock pest. A possible explanation is that parasites and predators may help control the fly.

Dung beetles (Scarabaeidae) may be a factor in control, since these insects break up, bury, or destroy cattle droppings. An intriguing method of biological control might be the introduction of dung beetle species adapted to areas of serious infestation. Or we might introduce parasites that develop in the larvae or pupae.

Prior to the introduction of parasites or predators, however, research would be necessary to make sure they wouldn't harm man, animals, or plants.

The face fly resembles a large housefly. It bothers cattle and horses by feeding on the mucus of the eyes, nose, and mouth, and on open cuts. There has been no evidence of this pest attacking sheep, goats, or swine at Beltsville.☆



This is a typical installation for collecting and storing much clean water for farms.

A WATER SOURCE WORTH EXPLORING

It could be a boon to farmers in semiarid areas

■ Watertight, nonabsorbent ground covers and enclosed reservoirs can be used to collect and store much clean water, USDA-Utah research shows.

In semiarid regions, many farmers have difficulty in providing water supplies for livestock and even household use. Reservoirs in natural drainageways are used to collect and store runoff water. But precipitation in these areas is small and generally falls on highly absorbent land surfaces. So runoff occurs infrequently, and much of the water that does reach the reservoirs later seeps into the ground or evaporates.

As a result, the reservoirs are empty much of the time. During acute shortages, farmers must haul water, sometimes from distant wells or streams, to supply minimum needs.

Even in the desert, if all precipitation could be collected and stored, small areas would provide much water. For example, rainfall on 1 acre of land in an 8-inch annual rainfall area amounts to about 217,000 gallons. This is enough water to supply 200 head of cattle for 100 days.

About 5 years ago, USDA and the Utah Agricultural Experiment Station began a search for improved, practical methods of collecting and storing rainfall runoff for livestock use.

ARS soil scientist C. W. Lauritzen found two ground cover materials that look extremely promising in test installations. One is butyl rubber sheeting, which has proved successful as lining for irrigation ditches and reservoirs. After 10 years as a ditch liner, the material showed no measurable deterioration except mechanical damage from livestock.

After 2 years, butyl sheeting has proved well suited for collecting rainfall runoff and shows no damage from weather or birds. The material is not penetrated by plants, which saves the cost of ground sterilization to prevent their growth.

The other material, asphalt-coated jute fabric, is less expensive than butyl sheeting but probably won't hold up as well. Lauritzen estimates that, given a small amount of maintenance, this material should give 10 years of satisfactory service. Since the fabric is readily penetrated by plants, the soil must be sterilized before the jute is laid.

Telvar was effective in experiments

Effective sterilization was obtained by spraying 2 pounds of Telvar (a soil sterilant) per 1,000 square feet. (If the fabric is to be laid immediately after this treatment, Lauritzen suggests a light supplementary application of polyborchlorate to prevent weed penetration until the Telvar takes effect.)

Studies of water-collecting areas showed that a 5-percent slope is preferable, although a little more or less is acceptable. A concave shape is required, and some earth work may be needed. All vegetation must be removed and large ridges and depressions smoothed out.

The cover is anchored to the ground by a trench dug around the outside edge. Extremely large covers may need extra anchoring at intervals. This can be done by having tails on the material and burying them in trenches at right angles to the edge.

To assure concentration of the runoff, ridges should be constructed along the edge of the cover. Overwash during heavy storms can be prevented by a diversion dike built just above the installation.

Closed storage offers advantages

Lauritzen stresses the importance of a good storage structure in any ground cover installation. If reservoirs are used, they should be lined with watertight material. A closed storage structure has the advantages of reducing evaporation and keeping the water clean.

In tests, Lauritzen used a collapsible bag of butyl-coated nylon. The bag, which held 1,600 gallons of water, prevented practically all evaporation, and provided clean water storage at relatively low cost.

A comparison of costs of ground cover materials indicates they may be installed for as little as $1.00 per square yard and will last 10 years or more. On this basis, an installation in an 8-inch rainfall area would cost about $3.10 per 1,000 gallons of water (amortized over 10 years at 7 percent interest). This cost would decrease if a longer lasting ground cover is used, or if the annual rainfall is higher.

Lauritzen believes large-scale demand would promote development of cheaper and more durable ground cover materials, as well as lower installation costs. He suggests, therefore, that individuals or groups in water-scarce areas give consideration to ground covers for developing farm-water supplies.☆

Fertilizer Reclaims Subsoil Exposed for Surface Irrigation

■ Subsoils exposed by land leveling for surface irrigation can be as productive as topsoils, if they're adequately fertilized, USDA-North Dakota research shows.

This finding, by ARS soil scientists C. W. Carlson and D. L. Grunes, should encourage farmers in the Northern Great Plains to step up conversion from dryland to irrigation agriculture.

In North and South Dakota alone, an estimated 1½ million acres could be irrigated with water from the Missouri River. Many farmers would like to use this water to obtain more dependable production, as well as greater flexibility in selecting crops that can be grown profitably. They hesitate because the leveling requires deep cuts that remove most of the top soil, and crop yields are reduced drastically.

Studies show that surface soils in these areas contain most of the nutrients available to growing plants. In tests of soil samples from Upham, N. Dak., for example, the scientists found that about half of the available phosphorus in the top 3 feet of soil was contained in the surface 8 inches. Two-thirds of the available zinc in the top 4 feet was in the top 12 inches. A cut of 6 inches from an acre of soil removed about 3,600 pounds of total nitrogen. This represented a loss of about 70 pounds of available nitrogen per acre per year.

In followup field tests on leveled land at Upham, the scientists compared yields of corn (for silage) grown in undisturbed soil and in subsoil (1 foot of topsoil removed), with and without added fertilizer.

The first season after land was leveled, nonfertilized plots in the undisturbed area produced 4 times as much corn silage and 9 times as much grain as plots on the cut area. But when 180 pounds of nitrogen, 44 pounds of phosphorus, and 15 pounds of zinc per acre were added, yields were about the same in both areas.

Manure applied to the cut area, at rates of 20 and 40 tons per acre, also increased yields but not as much as the nitrogen-phosphorus-zinc combination.

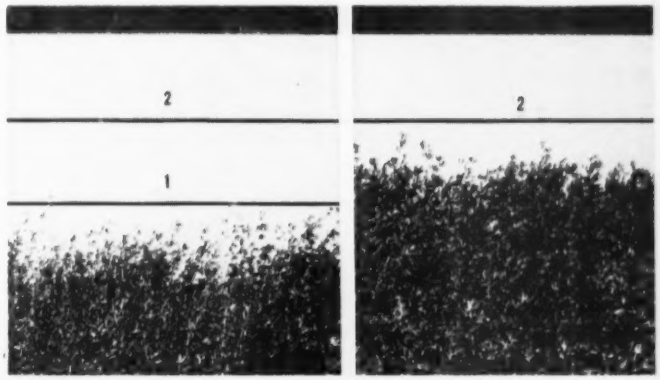
Nitrogen and phosphorus applied together were more effective than either applied alone. Zinc increased silage and grain yields on all plots except those receiving manure. Twenty tons of manure furnished enough zinc to meet the needs of the corn plants for high silage yields. But additional zinc fertilizer was required for maximum grain yields.

Studies were also made of residual effects of the various fertilizer treatments on the cut area. For sustained high yields, nitrogen had to be applied every year. A heavy application of phosphorus and 15 pounds of zinc were sufficient for 3 years. Benefits from manure were still evident 3 years after application.

When alfalfa was grown for 2 consecutive years on the cut area, the amount of nitrogen fertilizer needed by the succeeding crop was significantly reduced. A heavy application of phosphorus at the time the alfalfa was seeded resulted in maximum nitrogen fixation.

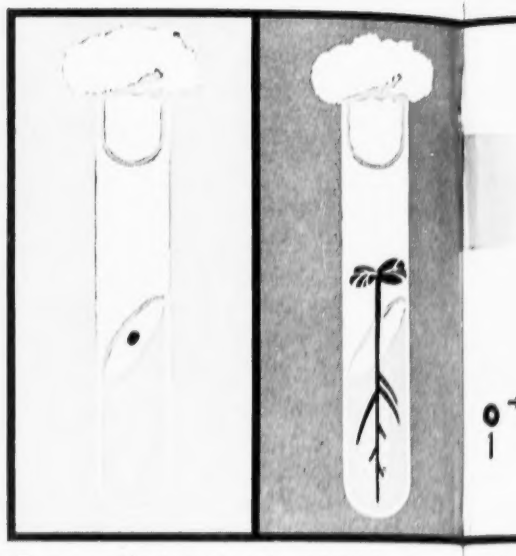
Mixing surface soil with the subsoil during land leveling reduced the need for phosphorus. At least 25 percent surface soil in the mixture was required, however, before appreciable benefits were obtained.☆

Phosphorus was added to the subsoil to increase alfalfa growth (right).



Better Cottons

Cotton flower is sliced in half to show location of ovules (arrow) in ovary.



Embryo (black dot in tube at left) begins growth on medium of high osmotic pressure is later moved to mediums of intermediate and low pressures. Germinated seedling at right is ready for transfer to soil.

Major breakthrough in basic research increases opportunities to transfer disease resistance and high fiber strength from wild to commercial cottons

■ A technique for growing immature cotton embryos in test tubes provides a new and reliable tool for utilizing valuable germ plasm from wild cottons to improve cultivated varieties.

The new technique demonstrates the role of osmotic pressure in growth and development of cotton embryos (future seed kernels). By manipulating the osmotic pressure (concentration of dissolved materials) in the test-tube solutions, USDA plant physiologist J. R. Mauney grew to maturity embryos removed from cotton plants only 7 days after pollination.

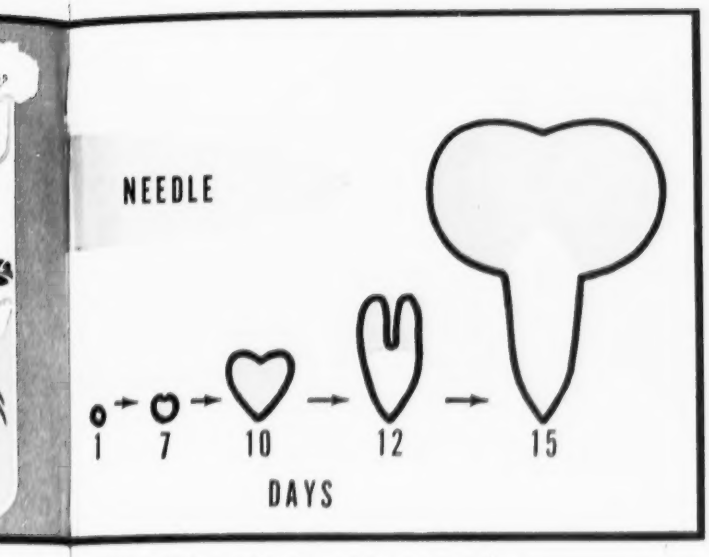
This is a major breakthrough in research aimed at transferring disease resistance, high fiber strength, and other qualities from wild to commercial cottons.

Wild species of cotton are found throughout the world. But with one known exception, these cottons have a different number of cell chromosomes and do not cross readily with U.S. cultivated varieties (AGR. RES., November 1960, p. 3). The few successful crosses are largely the result of time-consuming "cut and try" methods of breeding. In most cases, the hybrid seed doesn't germinate because of abortion or abnormal growth of the embryo, following fertilization of the ovule.

A normal, healthy cotton plant produces bolls containing 20 to 40 ovules or undeveloped seeds. In compatible crosses, most of these ovules develop into viable seeds that germinate readily when harvested, stored, and planted under proper conditions.

In incompatible cotton crosses, however, the embryo within the ovule develops normally for a week or so. Then abnormal growth begins, and the embryo eventually

tons Ahead



Size and shape of cotton embryo at various ages (compared to point of standard sewing needle at same magnification). Previous attempts to culture embryos at these ages have been unsuccessful.

dies or aborts. If a majority of seeds in a boll abort, it drops off the plant—usually within 10 days after flowering. Even though a few bolls may survive and mature, most of the seeds contain retarded embryos and fail to germinate.

Scientists have long tried to get around these difficulties by growing embryos in test tubes and transferring the seedlings to potted soil. Efforts were fairly successful with normal embryos cut out of the ovule after 3 or 4 weeks of growth in the plant.

The main trouble was that embryos from incompatible crosses rarely developed this long before they aborted. And those removed at very immature stages (before abnormal growth began) grew little or not at all in any of the test-tube solutions. The critical age varied with the species used, but more important was the degree of differentiation into plant parts achieved by the embryo before removal from the ovule.

Although these attempts failed, some results suggested osmotic pressure might be involved. Mauney, working with scientists at the North Carolina Agricultural Experiment Station, decided to find out.

He removed embryos 0.1 to 0.2 mm. long (first recognizable stage of differentiation) from self-pollinated bolls of Coker 100W, and cultured them in various physical and nutritional environments. Embryos responded best on a film of moisture over a medium hardened with agar to a semisolid. In the living plant, of course, embryos grow in the dark. But in the artificial culture, they developed chlorophyll faster when exposed to about 100 foot candles of fluorescent light. A 90° F. temperature was best for normal growth.

Manipulation of osmotic pressure was most important

The most important factor in Mauney's success was manipulating the osmotic pressure of the culture solution. He used a modified White's medium (a standard culture solution), and added an extra 0.7 percent of table salt to raise the pressure from its usual 2 atmospheres to 10. (One atmosphere is roughly equal to air pressure at sea level.)

After 3 to 4 weeks in the high pressure environment, the embryos were transferred to a solution with an intermediate pressure (6 atmospheres). This pressure was obtained by reducing the amount of added salt to 0.3 percent. After another 2 weeks, the embryos were transferred to a low-pressure solution (3 atmospheres) containing no extra salt. At this low osmotic pressure, the embryos germinated, and resulting seedlings were transferred to soil as self-sustaining plants.

The studies indicate that high osmotic pressure during the early culture period has two functions: (1) It prevents severe shock to immature embryos just removed from their natural high osmotic pressure environment; and (2) it promotes orderly development and differentiation and prevents premature germination.

The ARS scientist points out that the new technique is by no means perfect yet. Nor does it approach the efficiency with which normal embryos grow in their own plant environment. For example, an embryo removed 10 days after pollination must stay in artificial culture 3 to 4 weeks to attain a length of 2 to 3 mm. If left undisturbed in the plant, it would reach full maturity (about 10 mm.) within this time.

Also, the technique doesn't work with all embryos in every experiment. In some, large numbers of embryos responded well. In others, for unknown reasons, hardly any grew to maturity. The job ahead is to learn what makes the difference. Then a way may be found to get healthy embryos—and seedlings—every time.☆

Rust-Resistant Flaxes for the Future

They'll be kept for protection against new races that may attack at any time

A reserve stock of rust-resistant flax lines—to protect against attack by new races which may arise by hybridization, mutation, or introduction from another country—is being built up through cooperative USDA-State research.

Sixteen lines, each carrying resistance to one or more different races of the fungus (*Melampsora lini*), are ready for seed increase and commercial use, if the need arises. A few of these lines are resistant to all known North American races of rust. Breeding still in progress will eventually provide lines each resistant to many races and together resistant to every race now known.

Most flax varieties grown are resistant to all rust races known to occur in North America. But experience—with flax and other crops attacked by rusts—has shown the value of having a wide range of resistant plant material to counteract the genetic variability of the organisms that cause plant diseases.

ARS plant pathologist H. H. Flor developed the new lines in cooperation with the North Dakota Agricultural Experiment Station, Fargo. Agronomic characters were evaluated by ARS and the North Dakota, South Dakota, and Minnesota Agricultural Experiment Stations, under the leadership of ARS agronomist V. E. Comstock.

Rust-resistance genes were put in Bison

The new rust-resistant lines were produced by incorporating different genes controlling rust resistance into Bison, a variety with desirable agronomic characteristics which was in extensive use until damaged severely by rust in 1941–43.

Plant-pathologist Flor, winner of a USDA award for superior service, is spearheading development of a stock of flax lines that resist races of rust.

In field trials at Fargo, N. Dak., Brookings, S. Dak., and Morris and Crookston, Minn., the 16 new lines yielded as well as Bison and the widely grown varieties Marine and Redwood. Plant height, date of maturity, weight of seed per bushel, and oil content also compared favorably with the check varieties.

Only drawback of the new lines is that they, like Bison, have oil of a somewhat slower drying rate than is considered desirable. Iodine value, a measure of drying rate, ranged around 172 for Bison and the new lines. Iodine values of check varieties Redwood and Marine were 181 and 187, respectively. The difference between the high values of Redwood and Marine and the values of the new lines isn't great enough to hinder their use if needed.

The new lines are also sufficiently resistant to wilt and have some tolerance to pasmo.

Development of the new rust-resistant lines is the result of research conducted by Flor for many years, beginning with identification of different rust races and different varietal responses in flax to rust.

U.S. commercial flax varieties and the USDA world collection of flaxes were screened for resistance to native and foreign races in this country in the greenhouse during winter. Also, some lines were tested for reaction to certain foreign races by cooperators in other countries.

The genes came from several sources

The complex of genes responsible for differential resistance in flax was separated by using the selective pathogenicity of native rust races, new races produced in the laboratory by hybridization and X-ray-induced mutations, and introductions from other countries. The individual rust-resistance genes were then bred into separate lines of flax by backcrossing to

Bison. (Genes, the units of heredity, are borne on chromosomes in the nucleus of each cell.)

Twenty-five genes were found to determine resistance in flax and, correspondingly, 25 genes were found to determine virulence in rust. From this, Flor developed the gene-for-gene concept of the host-parasite relationship—that for each gene determining virulence in the parasite, there is a gene determining resistance in the host (AGR. RES., Dec. 1955, p. 3). This research also led to the finding of evidence of the nature of physiological resistance of plants to disease (AGR. RES., April 1960, p. 3).

Flax-rust relationship is complicated

The host-parasite relationship between flax and rust is complicated. The genes controlling virulence in rust exist in many different combinations, each combination constituting a new rust race; i.e., through genetic recombination, the rust may be able to attack lines which previously were resistant to it. Because rust reproduces sexually on flax, the possibility always exists for recombination of virulent genes to produce a new race.

And although 25 genes for resistance are found in flax, it isn't possible to incorporate all 25 into one variety. Eleven of the 25, for example, are alternates for one position on one chromosome; only one of these eleven can be incorporated into one plant. The other resistance genes seem to lie in four additional positions (loci) on the chromosomes, so it should be possible to develop flax varieties having as many as five resistance genes.

With the new lines, we have a good chance of protecting the flax crop against whatever new combination of virulent genes may arise in rust.

The value of resistance was effectively shown by a recent survey of flax fields in North Dakota—the surveyors found no rust.☆

That Stubborn
Johnsongrass

■ Why does Johnsongrass stubbornly resist control? In areas where this vigorously growing plant is considered a weed, practical control is extremely difficult.

Vigorous growth of Johnsongrass may be an advantage on certain grazing land where it's a valuable forage. But on cropland, Johnsongrass is one of our most troublesome weeds.

That's why USDA-State research is aimed at learning more about Johnsongrass. New information, scientists hope, will aid development of more effective ways to combat it. So far, some interesting things have been discovered about the plant's growth.

Findings indicate the importance, too, of early season chemical and mechanical controls. The studies are being conducted by ARS plant physiologist C. G. McWhorter, in cooperation with the Mississippi Agricultural Experiment Station, Stoneville.

How prolific Johnsongrass can be was shown by McWhorter in 1959 and 1960. Each Johnsongrass plant studied produced 212 feet of rhizomes (underground stems) and nearly 1½ pounds of seed *per season*.

In relation to top growth, rhizomes didn't grow fast (about 8 feet per plant) until bloom stage—at about 47 days of age. During the next 47 days, however, each plant produced about 85 feet of rhizomes.

Seedlings produce rhizomes from 3 weeks after emergence to maturity. Mature Johnsongrass plants produce other rhizomes that grow until frost, overwinter, then sprout new plants the following spring.

When comparing plants developing from seed with those emerging from rhizomes, the researcher found their growth habits almost identical.

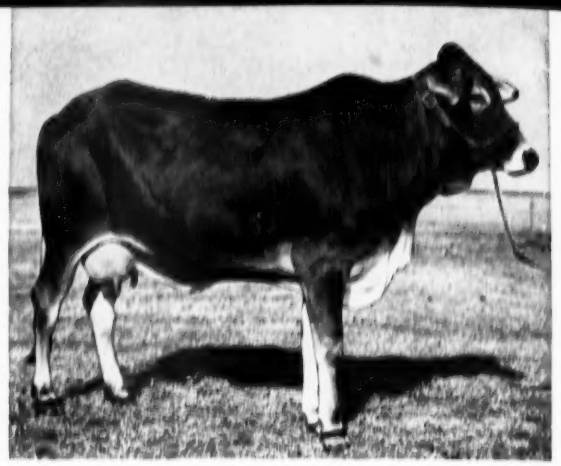
Two-week-old plants from seeds were killed by a single clipping (to simulate hoeing). Plants from rhizomes required two clippings for control. If clipping was delayed until plants were 3 weeks old (when rhizomes began growing), they survived eight weekly clippings.

A rapid change occurs in the plant's metabolism of food at bloom stage. This may help researchers determine why Johnsongrass becomes much more resistant to chemical control at (and after) this stage.

Soon after growth starts, the quantity of glucose and sucrose—the predominant sugars in Johnsongrass—drops to a low level. Johnsongrass is most susceptible to chemical control at this stage of growth. Glucose, an easily metabolized sugar, increases until blooming. At full bloom, glucose content drops sharply.

On the other hand, sucrose—a stored sugar—remains at a low level until bloom stage, then increases as glucose content drops.

Such fundamental knowledge of the growth and metabolism of weeds throughout their life cycle is essential to the development of efficient chemical, cultural, mechanical, and biological methods of control.☆



Jersey-Sindhi crossbred cow tolerates heat better than most Jerseys, but doesn't produce as much milk.

We've learned more about

Heat Tolerance and Milk Production

■ How to increase milk production continues to be a major problem in the South's expanding dairy industry.

Development of cattle adapted to the South—through breeding research—is one of several ways USDA and State scientists are trying to increase milk yields.

They gleaned valuable information from a recently completed crossbreeding experiment, using Jersey and Red Sindhi (Indian) dairy cattle in an attempt to develop heat-tolerant, high-producing animals.

The crosses didn't produce as well as the purebred Jerseys. First lactation milk yields of the Jersey-Sindhi cows ranged from 100 to 9,000 pounds. Cows with the most Sindhi inheritance gave the least milk; those with higher Jersey inheritance produced more.

In addition, the experiments revealed that the crosses were more temperamental, slower eaters and milkers, had shorter lactations, and were poorer feed converters than the Jerseys.

The crosses were more heat tolerant than the Jerseys, as shown by less physiological discomfort in extreme heat and high humidity. However, the studies indicated that there are much greater heat tolerance variations within the European breeds of cattle than has previously been assumed. In fact, a few purebred Jerseys were as heat tolerant as the crosses.

Also, other ideas on heat tolerance have been revised as a result of the experiments using Sindhis.

For instance, the belief that Sindhis are more heat tolerant because of their humps, hanging dewlaps, and loose skin covering has been discarded. Research shows that Sindhis withstand heat better because they breathe faster than European cattle, don't take as much air in their lungs, and produce less metabolic heat.

These efforts to transfer Sindhi heat tolerance to Jerseys illustrate how difficult it is to incorporate a single characteristic into a breed *without* affecting milk yields.

The experiments were conducted at the Iberia Livestock Experiment Station, Jeanerette, La., the Georgia Coastal Plain Experiment Station, Tifton, and the Agricultural Research Center, Beltsville, Md.

Scientists at the same stations are continuing efforts to develop cattle better adapted to Southern climates. To exploit knowledge of the wide heat tolerance variations in European breeds, they are selecting animals with the most heat tolerance to make within-breed improvements.

In other research involving crossing among breeds, the scientists are attempting to develop crosses which will express selected traits of their parents. It's also possible that an expression of hybrid vigor in the crosses might make the animals adaptable to Southern climates.☆

PREDICTING WOOL SHRINKAGE

■ Application of a recently developed low level gamma ray detector may lead to a new and more efficient method for predicting the shrinkage of raw wool. This shrinkage is an important factor in quality of raw wool.

Raw (grease) wool emits more gamma ray radiation than scoured wool, a team of ARS and Agricultural Marketing Service scientists found. Gamma rays from a natural isotope of potassium in the wool register on the new, highly sensitive counter. This isotope, potassium-40, occurs in the same small proportion in all natural potassium deposits and emits a low level of gamma ray radiation.

Probably most of the potassium-40 is in the suint (dried sweat) of raw wool. Suint is primarily a mixture

of water-soluble salts, many of them high in potassium.

Impurity removal accounts for shrinkage

Impurities account for 25 to 30 percent of the weight of grease wool. Removal of this debris—the wool grease, suint, and dirt—in the scouring process accounts for shrinkage of wool. Since grease wool is bought and sold on the basis of its estimated weight after scouring, buyers and growers need an accurate means of predicting shrinkage.

Using current methods, an experienced buyer can estimate the yield of a lot of wool to within 10 percent of its finished weight. Objective methods now in use for predicting clean yield involve scouring and weighing of small samples. A rapid, more reliable, and less expensive objective method is needed.

If further research indicates feasibility, the new method would be faster than any present means of measuring wool impurities. Materials need no special preparation before their radiation can be counted by the new detector. Wool is merely placed in a fiber drum for analysis.

Grease wool from Maryland, New Mexico, and Idaho was used. Six samples of wool were collected from one location in each State and compared with half a dozen scoured wool samples sheared from Idaho sheep a year earlier. Each test lot weighed between 4.0 and 5.6 pounds, about the weight of one clean fleece.

Scientists conducting the studies are biochemist R. Kulwich, chemist L. Feinstein, agricultural engineer R. W. Decker, and chemist C. Columbic of AMS; and fiber technologist Mary E. Hourihan and animal husbandman C. E. Terrill of ARS.

Additional experiments are underway

To learn more about the effects of environment and geographical variations on wool, the researchers are studying test sheep moved from Idaho to locations in Georgia, New Mexico, and Beltsville, Md. Measurements of wool from these sheep will be compared with those of wool sheared from the same animals in Idaho before the move and with wool from sheep remaining in Idaho.☆

HOW IMPORTANT IS DAIRY TYPE?

■ Type classification significantly affects the sale value of dairy cattle. Milk production, however, is so slightly related to type that dairymen frequently ask: How much emphasis should be placed upon type?

The answer, according to N. D. Bayley, ARS dairy husbandman, depends on the importance of cattle sales to the income of individual dairymen.

Breeders of purebred cattle recognize that, in the sale ring, type is as important as production—so they strive to improve appearance and conformation. But dairy cattle sales account for only about 50 percent of gross income, even in the most outstanding purebred herds. So breeders should keep production and type improvements in proper relationship, Bayley says.

Selection for a single trait (in this case, production) results in the most rapid improvement that can be expected for that trait. When selection is also made for a second trait (type), production improvement is slowed. (See AGR. RES., October 1960, p. 5.)

How much can production improvement be retarded by emphasizing type? By 12 to 15 percent if an increase in type grade (i.e., *Good* to *Good Plus*) is considered as important as raising milk production by 1,500 pounds per cow in a Holstein herd.

If increasing one type grade is emphasized as much as increasing production 2,500 pounds per cow, progress towards improved yields will be reduced 29 percent.

For the few dairymen who have developed highly productive herds and want to emphasize cattle sales, type can be markedly improved by allowing one grade increase as much emphasis as raising production 2,500 pounds in Holsteins, or 2,100 pounds in Jerseys. At the same time, it should be realized that when type is emphasized, production progress is slowed.

For the majority of dairymen wanting only higher milk yields, type should be largely disregarded.

Only 2 to 6 percent of the average dairyman's income is dependent on type variations. USDA researchers have found that, for most dairymen, raising milk production is at least 20 times more important than improving appearance.

Many dairymen rely on artificial insemination organizations for their herds' breeding needs. How much emphasis should these organizations place on type?

Bayley recommends that they place no more emphasis on superiority of one type grade than on 1,200 pounds of milk. For example, a cow classed *Good* should be chosen over one rated *Good Plus*, providing *Good's* milk yield is 1,200 pounds more than the other's.

He acknowledges that the organizations have an obligation to serve clients who emphasize cattle sales. But he believes the organizations have a greater obligation to serve the more than 95 percent of U.S. dairymen who derive almost all their income from milk sales.☆

A NEW WAY TO GAGE LEVEL OF LIVING

It's called value of consumption and is much more reliable than a measure based upon money spent

■ Value of consumption—that's the term USDA home economists are using to describe a new measure of family level of living.

This measure—more reliable than one based on money spent—is useful for determining economic well being and for comparing the level of living of farm and nonfarm or urban families. It is especially needed in the Rural Development Program (AGR. RES., May 1958, p. 3; September 1960, p. 3) to determine how well off particular groups of families are.

With it, extension workers (and others concerned with helping families make best use of resources) can compare levels of living attained by families who farm and those who obtain their living in other ways.

To calculate annual value of consumption, the estimated money value of home-produced or gift food and fuel is added to annual cash expenditures for nondurable goods and services. Also added is the money value of a year's depreciation on the family home, furnishings and equipment, clothing, and on the family share of automobiles and trucks.

Institute of Home Economics researchers compared the two measures—value of consumption and expenditures—by applying them to data from rural families with incomes of less than $2,500 a year. The data were collected in two surveys in low-income areas. One survey, in cooperation with the Kentucky Agricultural Experiment Station, covered five counties in south-central Kentucky. The other, in cooperation with the Texas Agricultural Experiment Station, dealt with five counties in eastern Texas.

The value of consumption of goods and services used by Kentucky families in a year was about half again greater than expenditures—$2,448 compared with $1,617. One reason was home production. Families produced more than half of the food they used, and added to their fuel supply from wood growing on the farm.

Another reason was that the value of a year's use of the family home was several times greater than the direct outlay on it. Value of consumption of clothing was half again as great as expenditures because garments were made at home or received as gifts.

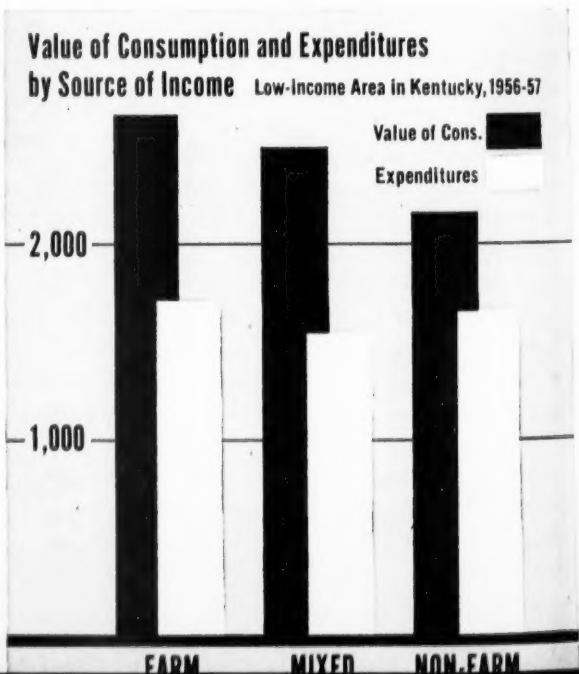
But expenditures were greater than value of consumption for house furnishings and equipment, recreation, and transportation. The families added more to their stocks of durable goods in these areas than they consumed during the year.

When home production of food is relatively low, as it was in the Texas area studied, less difference is found between expenditures and the value of consumption of all goods and services used during the year. The Texas families differed from those in Kentucky also in that they were not building up stocks of durables. On the average, they consumed about as much of household goods as they bought and somewhat more of their automotive equipment than they replaced.

The researchers found that measuring level of living by expenditures understates the position of families with the lowest incomes, those dependent in whole or in part on farming, and those older.

For example, Kentucky families completely dependent on farming had a value of consumption 26 percent greater than those dependent on nonfarm sources of income—although their expenditures were about the same.

The position of elderly families did not contrast so poorly with that of young families when measured by value of consumption as when expenditures were the measure. Per capita value of consumption among Kentucky families whose heads were 70 years of age or older was slightly greater than among those with heads under 40—even though older ones spent almost a fourth less.☆



Sugarcane virus is named strain H

A mosaic virus that has been damaging Louisiana sugarcane since 1956 was recently identified and named strain H by a USDA scientist.

A similar mosaic virus, combined with two other diseases, caused serious sugarcane losses in the 1920's.

Strain H mottles sugarcane leaves and causes plants to become chlorotic and stunted, greatly reducing cane yields. The sugar content of mill cane, however, isn't affected.

This disease is confined to the Louisiana "Sugar Belt," with heaviest infestation along Bayou Lafourche and the lower Mississippi River, according to ARS plant pathologist E. V. Abbott at Houma, La. He identified the new virus strain.

All available commercial varieties of sugarcane are susceptible to strain H. Until resistant varieties are developed, the disease can be checked by roguing out (removing) diseased plants in seedcane plots. It doesn't pay to remove diseased canes in plantings to be used for sugar, Abbott says. As early as they can be detected in the spring, diseased plants should be dug from fields that are to be used for seedcane.

Abbott and his associates, cooperating with the Louisiana Agricultural Experiment Station and the American Sugar Cane League, are attempting to develop varieties resistant to strain H.

New spring oat to be increased

Seed of Nodaway, a new spring oat variety, has been released to certified growers for increase and should be available from them for commercial production in 1962.

This early maturing oat was developed primarily for growth in Missouri, but is adapted for production in neighboring States. Nodaway has strong roots and stiff straw, giving it good standing ability. It is highly resistant to smut and present races of stem rust, and has moderate resistance to crown rust. However, Nodaway is susceptible to yellow dwarf disease.

Nodaway matures 2 to 3 days earlier than Clintland, is slightly shorter in height than Macon or Mo. 0–205, and averaged 69 bushels per acre in 4 years of testing in Missouri. Macon averaged 67 bushels and Mo. 0–205 and Newton 66 bushels.

Nodaway grain is white, short, and plump. It has the highest test weight of any variety commonly grown in Missouri, and good milling quality.

One parent line of Nodaway was Columbia-Marion, the same line from which Macon was selected. Nodaway's other parent line came from Canada.

Nodaway seed isn't available from USDA, which cooperated with the Missouri Agricultural Experiment Station in developing the oat. It resulted from research by Missouri station agronomist J. M. Poehlman, who worked with ARS.

Two soybeans will be released

Seed of Bethel and Kent, new disease-resistant soybean varieties, will be released this spring for increase by certified growers and should be available for commercial planting in early 1962.

These soybeans were developed cooperatively by USDA and several State Agricultural Experiment Stations. No seed will be supplied by USDA.

Bethel is resistant to *Meloidogyne incognita acrita*, a species of root-knot nematode, to pod and stem blight, and frogeye leaf spot. Its plants grow to medium height (46 inches), are erect and branching, and have white flowers. This soybean produces medium-size yellow seeds with a yellow seed scar.

Bethel has the highest protein content (41.6 percent) of any commercial soybean that matures at the same time. It also has a high (21 percent) oil content. It matures 6 to 10 days after Clark and Wabash and 4 to 8 days before Dorman and Hill. Bethel averaged 43.8 bushels per acre in field

tests conducted in Delaware for 2 years. Clark averaged 45.4 bushels per acre. Bethel will be released in Delaware and Maryland.

Kent is resistant to lodging, frogeye leaf spot, and some races of downy mildew. It's adapted to Delaware, eastern and central Maryland, southwestern Indiana, southern Illinois, and southeastern Kansas, and will be released in these States only. Kent is high in protein (41 percent) and oil (22 percent).

Its plants have dense, dark green, spreading foliage, and grow about as high as Bethel. They have purple flowers and produce large yellow seeds with a black scar. Kent matures about 9 days later than Clark.

Woodard is for the deep South

Woodard, a new blueberry that makes commercial production economically feasible for the first time in the deep South, has been developed and released by USDA and the Georgia Coastal Plain Experiment Station.

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Woodard is a rabbiteye type—as the fruit begins to ripen the pink color resembles a rabbit's eye. These types are adapted to the Deep South because they require only a short rest period in winter.

Woodard requires pollination by another rabbiteye for high commercial yields. It should be grown with Tifblue, the only other rabbiteye with a high commercial potential.

Berries of Woodard are larger than those of other rabbiteyes, averaging 91 berries to a half-pint cup. The berries are light blue and tangerine-shaped. They are the earliest ripening—12 to 14 days before Tifblue—of the modern rabbiteyes.

Woodard berries have good shipping quality, and the fruit does not crack in rainy weather following a dry period. Yields are comparable to those of Tifblue.

Woodard has slightly more acid flavor than Tifblue, which makes it a more highly desirable berry for pies and similar uses. It also is highly acceptable for fresh market use. Plants of Woodard are more spreading than Tifblue plants.

Woodard plants are available from nurserymen. None of the plants will be supplied by USDA.

The new berry was developed by horticulturists G. M. Darrow, now retired from ARS, and W. T. Brightwell of the Georgia station at Tifton. This blueberry was named in honor of Otis Woodard, who supervised fruit research at the station until his retirement early last year.

Detector gages fallout in fields

A transportable detector that accurately gages atomic radiation in contaminated fields has been designed by USDA scientists.

It was built for use in Atomic Energy Commission experiments conducted by ARS at the Agricultural Research Center, Beltsville, Md. Tests are underway there to determine the best means of removing atomic fallout from farm land.

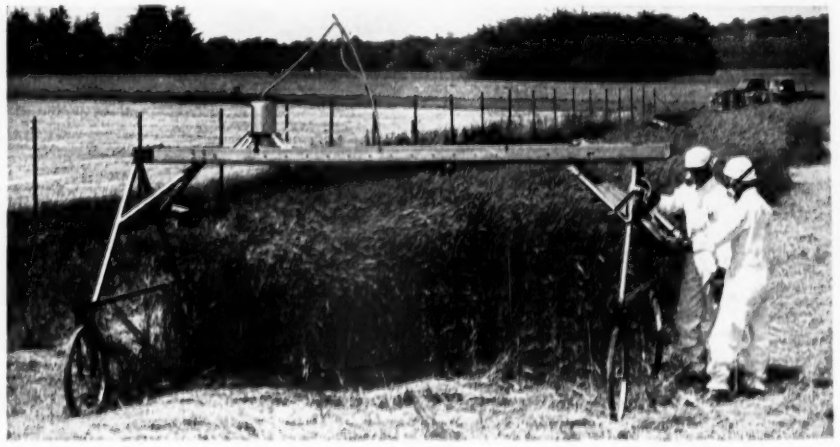
Artificial fallout is spread on growing crops and bare soil. After contamination, radiation is measured. Then the crop or top soil layer is removed and activity remaining on the ground is measured.

Prior to the detector's development, artificial fallout on cropland was gaged by taking soil samples before and after contamination and counting their activity with radiation measurement devices. Although this is satisfactory on bare soil, it isn't as convenient as desired for measuring contamination on crops.

Much of the fallout remains on plants and can't be measured in soil samples. Crop roots prevent easy removal of the samples; they are hard to take in dry sandy soil.

The detector, designed by ARS agricultural engineer P. E. James and soil scientist R. G. Menzel, basically consists of two aluminum beams mounted on a frame supported by four wheels. A carriage that moves on the beams contains the detection equipment. A pulse counter—a device for measuring radiation—is mounted at one end of the beams.

The detector can be transported by elevating one end and moving the equipment on two wheels.



Radiation in artificially contaminated rye field is checked by ARS scientists. They are studying ways to remove fallout from fields.

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